iron in consequence of the difference in specific gravity of the two. When the furnace is tapped, the iron runs off to the pig-bed to be cast into the well-known form. The slag is usually run into boxes, which are mounted on wheels. The passion for bigness which in the present day characterizes nearly all engineering operations of this nature, has extended to slag handling, so that a box will sometimes hold as much as four tons of slag. When the mass is sufficiently cool to stand alone the sides of the mould are lifted off by a crane, and the bogie is drawn away to the "tip," or "slag mountain," by a locomotive. As the land covered by the "tip" is often very valuable, in some localities being worth as much as £1000 per acre, it is desirable for this reason alone that the slag should be dealt with in some other way. When the iron-works have a sea outlet, the slag is often taken away in vessels constructed for the purpose, and dropped in deep water. The difficulty here is that the big lumps, or "slag-balls," are difficult to handle. To lower them gently into the barge is too costly, and if they are shot in they are likely to start the rivetting. Hand-breaking was, therefore, had recourse to—a tedious and costly process. In order to overcome this difficulty, an ingenious plan, known as the dry core system, has been devised. A hollow iron casting was placed so that the slag would flow round it when run in the mould. This was done so that the slag in cooling would contract round the casting and break up into pieces small enough to be tipped into the barge without injury to the plates and rivetting. Mr. Hawdon has not found this method to be successful; but it is stated that others have followed the plan with advantage. In America a method known as "slopping" is used, and undoubtedly with success. The molten slag is run on to a surface, and a large but comparatively thin cake is so obtained. When this layer is sufficiently cool, another is formed above it, and then other layers, so that the whole forms a stratified mass, with planes of demarcation between. Such a body is broken up with comparative ease. Sometimes the slag is taken away in the molten state in "boats" which are simply tanks on wheels. It is then poured away, leaving a problem for the engineers, and perhaps the geologists, of future generations to solve. There have been other methods of dealing with slag, but these we have not space to describe. Mr. David Joy, a well-known mechanical engineer, took the matter up about twenty years ago, and spent a year or two upon the problem. Some of the devices he originated were extremely ingenious, but for reasons of a commercial nature, his efforts were not continued. There are some uses for furnace slag. It is made into bricks, it is drawn into slag-wool, it is made into cement, and is broken up for ballasting railways, pitching streams, or, when made into concrete, for harbour and breakwater works. In spite of these uses, the great bulk of the 12,000,000 tons produced each year has to be tipped to waste, and the disposal of this useless by-product is no small part of the iron-master's expense in running his works. It is to aid this that the apparatus before referred to has been devised by Mr. Hawdon. It consists mainly of two large pulleys, over which there runs an endless chain or a metal belt. The pulleys are mounted on horizontal shafts, parallel to each other, and placed in the same horizontal plane. The pulleys are driven by a steam-engine, and the chain is made to travel in this way. The latter is composed of solid bar links, joined by pins, and on it is mounted a continuous series of shallow pans or trays. At one end of the apparatus the stream of molten slag is directed into the pans, and, as the chain is moving continuously, each pan carries off a part of the material. The pans overhang, so that the metal will not spill on to the links. Between the two pulleys there is placed a large flat tank filled with water, and this is so arranged that the upper part of the endless travelling chain or belt dips into the water, the sag of the belt being sufficient for the purpose. There are guide rollers, but these are details which may be neglected in our explanation of principles. The slag flows into the trays just before they dip into the water, so that the molten metal is at once rapidly cooled. This has the effect of cracking the pieces so much that when they fall out of the trays—which they naturally do when the belt turns over the further pulley—into the barge or waggon, they are broken into convenient sized fragments. Mr. Hawdon claims that by this system a very large saving is effected in transporting slag, and a material of some commercial value is obtained, the pieces being of suitable size for railway ballast or concrete mixing. From what we hear of the apparatus it appears to do its work well so far.

The summer meeting of the Institution will be held this year at Portsmouth, on July 26 and three following days.

THE ELECTRICAL EXHIBITION.

ON Saturday evening last the Lord Mayor and the Lady Mayoress, accompanied by Mr. Sheriff Tyler, Mr. Sheriff Foster, Sir John Monckton, and many others, went to the Crystal Palace to inspect the Electrical Exhibition. After their walk round, which lasted about an hour and a half, the visitors were entertained at dinner in the large saloon off the south transept. Among the company were the Attorney-General, Sir Robert Rawlinson, Sir Frederick Abel, F.R.S., Prof. W. E. Ayrton, F.R.S., Major-General Webber, Prof. W. Crookes, F.R.S., Mr. Tesla, Mr. W. H. Preece, F.R.S., Sir James N. Douglass, F.R.S., Major-General Festing, F.R.S., Dr. Hopkinson, F.R.S., Mr. A. Siemens, Prof. Kennedy, Prof. Forbes, Prof. Robinson, Prof. Perry, Prof. Hughes, and Prof. Silvanus Thompson, F.R.S. In the unavoidable absence of the Chairman of the Crystal Palace Company, the Hon. D. J. Monson, the chair was taken by the Deputy-Chairman, Mr. G. T. Rait. After the usual loyal toasts, the Lord Mayor proposed "Success to the Exhibition." In doing so he said there was sufficient evidence to warrant him in predicting that the Exhibition would prove a very great success. He recollected how, ten years ago, the electric light occupied the minds of many people, and how at that time the light had what proved to be a very bad start. The light was then undertaken more as a speculation. This checked for a time electrical enterprise, though, in his opinion, it had done no great or permanent harm. He admitted, with some degree of shame, that in the City of London they had been very slow to move in the matter. It was possible that they might have hesitated to commit themselves to some appliance that might have been changed on the morrow. They were, however, in favour of the electric light, and the City had been handed over to the new lighting, which in a short time would be an accomplished fact.

Dr. Hopkinson, in giving "Electric Science and Industry," remarked that the reaction between these two had been very intimate.

Prof. Ayrton, President of the Institute of Electrical Engineers, who responded, said that it was impossible to imagine what progress would be made in electricity in another ten years. At present two conductors were necessary for every electric tramcar (laughter). They had anticipated his joke (renewed laughter). One conductor took the current, while the other took the current coin (laughter). It might be that in ten years street lamps would be no longer necessary, as vacuum tubes would be used for walking-sticks (laughter). The smoke plague and fog would no longer trouble us, for there would be no coal fires when we could bask in the rays of the electric field, repose in the genial warmth of an equipotential surface, and put our feet on a fender composed of horizontal lines of force (loud laughter). One suggestion he would make—that the electric light might be introduced into that room, for the warmth they had borne during the dinner had been surpassed only by the warmth of their reception by the Directors of the Crystal Palace (laughter).

Mr. R. E. Crompton, President of the Electrical Section of the London Chamber of Commerce, also responded.

Mr. E. Clark proposed "The Health of the Honorary Council and Committees of the Exhibition."

Sir F. Abel, in responding, declared that we were on the threshold of great advances in our knowledge of electricity and its applications.

Mr. W. H. Preece also responded, and congratulated the promoters of the Exhibition upon the fact that they had brought to bear upon the present position of electrical science a fierce and an impartial criticism.

Mr. Tesla acknowledged some compliments paid to him in the course of the evening.

Sir James Douglass gave "The Crystal Palace Company," and the Chairman responded.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. J. J. Lister, of St. John's College, late Assistant Superintendent of the Museum of Zoology, has been appointed Demonstrator in Animal Morphology, in place of Mr. S. F. Harmer.

Mr. Alexander Scott, of Trinity College, has been appointed

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Demonstrator to Prof. Dewar. The grace for establishing the office was opposed, but carried by 76 votes to 70.

Prof. Macalister has been appointed Chairman of the Examiners for the Natural Sciences Tripos in the present year.

The Fitzwilliam Museum Syndicate report that the catalogue of the Egyptian Collection, prepared by Dr. Budge, is now ready for printing, and will forthwith be published.

SCIENTIFIC SERIALS.

THE *American Meteorological Journal* for December last contains six memorial articles upon the work of the late Prof. W. Ferrel, read at a meeting of the New England Meteorological Society in October last. Prof. W. M. Davis states that Ferrel's view of the general circulation of the atmosphere is now accepted in its essential features by most meteorologists; and were it not for the silence regarding it on the part of some of the British school, it would be regarded as universally acceptable. But in Great Britain it finds little recognition; unfortunately, Prof. Davis thinks, for the advance of the science in this country. The essential part of Ferrel's theory, first stated in 1859, is that an equatorial-polar convectional circulation on a rotating earth must consist chiefly of oblique winds from a western quarter, with high velocities nearly at right angles to the gradients; and that the initial high pressure about the poles, due to low temperature, will be reversed to low pressure by the excessive centrifugal force of the whirling winds, thus leaving a belt of high pressure near the tropics. He draws a sharp contrast between the general circulation and the cyclonic circulation. Both are cyclonic, inasmuch as they whirl, but one has a cold centre, and the other a warm one.—H. Helm Clayton contributes an article on the verification of weather forecasts. Among the elements to be considered he includes (1) the kind of phenomenon, *e.g.* cloud, rain, &c.; (2) the time of occurrence; (3) the duration of the phenomenon; (4) the intensity; (5) the length of time in advance that the phenomenon is predicted. He also describes the methods of verification adopted in some countries.—Cold waves, by Dr. A. Woeikof. The object of the paper is to disprove Prof. Russell's theory that cold waves are not due chiefly to radiation from the ground, but to extreme cooling of the upper air. Dr. Woeikof shows from observations from various sources that the cold waves are certainly due to radiation, not necessarily at the place where the cold is felt, but at a distance—in the United States to the north-west, in Europe to the north-east.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 21.—"On the Mechanism of the Closure of the Larynx: a Preliminary Communication." By T. P. Anderson Stuart, M.D., Professor of Physiology, University of Sydney, Australia.

The epiglottis having been displaced from its time-honoured function of closing the larynx as a lid, the paper proceeds to show how after all the larynx *is* closed. Briefly, the closure is effected by, on the one hand, a folding up of the margins of the entrance and an obliteration of the channel of the vestibule from the entrance downwards to the level of the glottis, and, on the other hand, by the well-known movement upwards and forwards of the entire larynx against the base of the tongue—the lower part of the epiglottis intervening, but taking no active part in the process. The observations, &c., were made as follows: (1) on a man who has a large hole in the side of the neck, a result of an operation for epithelioma, through which deglutition, simple closure of the larynx, &c., can be observed proceeding in a manifestly perfectly normal manner; (2) on healthy persons examined by the laryngoscope by the author and by two professed laryngoscopists; (3) experiments on the different classes of animals; (4) the anatomy and comparative anatomy of the parts; (5) the clinical and *post-mortem* records of morbid conditions.

When simple closure is to be effected in man, the arytenoid cartilages, inclosed in the mucous membrane, (1) are rotated, so that the vocal processes (eventually) come into apposition; (2) glide forwards on the cricoid articular surface, so that the posterior broad part of their articular surface comes to rest on the cricoid; (3) approach each other, so that their inner faces are, in part at least, in contact; (4) fold forwards at the crico-arytenoid joint, so that their tips come into contact with the lower part of the epiglottis. At the same time the aryepiglottic folds become tense, pulling inwards the lateral margins of the epiglottis, and so deepening its groove to receive the tips of the arytenoids and the Santorinian cartilages. Thus the entrance assumes the form of a squat **T**-shaped fissure, its transverse limb bounded in front by the epiglottis, behind by the ary-epiglottic folds, and its vertical or antero-posterior or mesial—the more primitive—limb by the arytenoid cartilages. The head of the **T** is curved concave backwards and its stem is short. A *slight* movement of the entire larynx upwards and forwards takes place—not nearly so much as in deglutition. The epiglottis does not *actively* move, and in deglutition, for instance, the bolus is seen to glide over its laryngeal surface, its lingual surface being closely pressed against the dorsum of the tongue. But all animals are not alike, and too little account has been taken of differences in the anatomy of the parts, these carrying with them, as they do, differences in their physiology. The foregoing account applies only where, as in man, the arytenoids are long and narrow: where they are high and broad they move more bodily forwards, and where they are low and narrow, *i.e.* small, neither folding nor movement forwards would suffice to close the orifice, and there the lower part of the epiglottis is permanently bent backwards, so that the contact of the arytenoids with the front wall of the laryngeal cavity is effected with a minimum of movement of the arytenoids and the true vocal cords are, as it were, under cover of a sort of hood formed by the epiglottis. The exact behaviour of the distal portion of the epiglottis varies; so does the value of the movement upwards and forwards of the entire larynx, even in individuals of the same species. The arytenoids in their mucuous membrane thus form a valve which, when it stands backwards, closes the food-channel and drafts the air forwards into the larynx, and when it lies forwards in deglutition closes the air channel and opens the food-channel. The external thyro-arytenoid muscles with the transverse arytenoid muscle, are the agents by which the before-mentioned four movements of the arytenoid cartilages are brought about. The aryepiglottic muscles tense the edge of the aryepiglottic fold, and cross to the base of the opposite arytenoid cartilage to avert the tendency they would otherwise have to pull asunder the arytenoids' tips. As worked out in the paper, it is seen that a very large number of details in the anatomy of the larynx receive an adequate explanation by this account of the closure of the larynx, *e.g.* the detailed anatomy of the muscles just mentioned, the sacculus, the structure of the false cord, the crico-arytenoid joint, its surfaces and ligaments, the anatomy of the larynx and its cavity in the different classes of animals, the ephithelial lining the cavity, &c.

"Birds are extremely instructive in this connection. Here the vocal function is entirely removed from the larynx, so that the larynx has for its sole office the guarding of the entrance of the trachea. Inspection and experiment show the entrance to be closed by the arytenoid cartilages, or bones, and the thyro-arytenoid muscles. Since this is their function in Birds (and the same applies to Tortoises, Lizards, Reptiles, Frogs, &c.) is it not all the more likely to be at least a function in Mammals?"

The plane of the larynx at the level of the glottis corresponds to the larynx in its more primitive forms—linear when closed, lozenge-shaped when open, bounded exclusively by cartilage and muscle. In man the vocal function has been superadded: all that lies above the level of the glottis has been built on that level, and the vibrating property has been got at a physiologically cheaper rate through fibrous than through muscular tissue. For details we must refer to the paper in the Proceedings.

January 28.—"Note on some Specimens of Rock which have been exposed to High Temperatures." By Prof. T. G. Bonney, D.Sc., LL.D., F.R.S.

The first described were two specimens of the microgranite of Threlkeld (Keswick): the effect of heating (probably to about 2000° F.) had been to melt down the felspathic and the micaceous constituents, cracking, but not materially affecting, the quartz. Next, in overburnt brick (composed mainly of disintegrated granite) from Les Talbots (Guernsey) similar effects: partial melting of larger fragments of felspar: in one case twin planes could be traced within the melted part. Thirdly, five specimens of melted basalt from Rowley Regis. Four of these

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